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APPARATUS FOR THE DISTRIBUTION OF A RANDOM STREAM OF  
CYLINDRICAL ITEMS, FOR EXAMPLE DRINKS BOTTLES, INTO SEVERAL  
LANES  
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Description

The invention relates to an apparatus for the distribution of a random stream of cylindrical items, in particular drinks bottles, into several lanes in which the items are transported individually one after the other. The apparatus has a  
5 transport device for the items, the transport device having one or more driven conveyor belts and side rails. The conveyor belts are generally arranged running parallel alongside each other at a short distance, so that they virtually form a closed transport surface and the items can slide from one  
10 conveyor belt onto the other. The apparatus also has a lane divider which includes several dividers which divide the space between the two side rails into individual lanes, the width of which is slightly greater than the diameter of the items, so that the items in the lanes are transported individually one  
15 after the other. The lane divider is connected to a driver whereby the dividers are movable back and forth.

Such distribution apparatuses are used in drinks bottling plants between the filling device and the packaging station.  
20 The drinks bottles coming from the filling device are firstly collected in a buffer. The buffer consists of an area formed from several conveyor belts lying parallel which represents a widened section of the transport device. The bottles are transported from this buffer to the distribution apparatus by  
25 banking-up pressure. The distribution of the bottles into individual lanes is necessary, as only in this way can the bottles from the packaging station be received and then fitted into boxes or other packaging with a specific number of bottles in each case.

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The problem with distribution apparatuses is that the bottles can become wedged or form bridges and then are no longer taken along by the transport device.

5 A distribution apparatus is known from US 4 173 276 in which the dividers are fixed at their downstream end and attached at their upstream end to a bracket which spans the transport device and is movable back and forth.

10 A distribution apparatus is known from EP 1 038 808 in which the random stream of bottles is distributed into four lanes. Three dividers are arranged between the two side rails, the middle one projecting somewhat further forward. The front ends of the dividers are developed as a swivellable flap, moved by  
15 a motor. Sensors serve to detect a blockage of the items and when a blockage occurs the flaps are swivelled by the motor.

A similar distribution apparatus is known from DE-C2-39 26 735, the bottles being distributed into eight parallel lanes  
20 lying alongside each other. The front ends of the dividers are arranged staggered and the middle divider projects furthest forward. In order to facilitate the entry of the bottles into the lanes the dividers can move transversely to the transport device.

25 Plastic (PET) bottles, because of their elasticity and the greater friction coefficient of plastic, have a particularly marked tendency to become wedged against one another and thus cause a blockage.

30 The object forming the basis of the invention is to create an apparatus for the distribution of a random stream of items into individual lanes which largely prevents the appearance of such blockages also in plastic bottles.

According to the invention, this object is achieved in that the lane divider has a frame, to which the dividers are fixed, and that the dividers are moving back and forth simultaneously in the direction of transport and transversely to it.

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The dividers are fixed to a common frame which is arranged above the transport device. The dividers can be plates or rails composed of individual rods which are suspended from the frames, so that they are at a short distance above the  
10 transport device. In general the dividers run parallel to the direction of transport. They can however also run at an angle. Rollers with a diameter of a few millimetres extend along the upstream-side edges of the dividers.

15 The speed of transport is in general set such that the items accumulate in front of the lane divider. This is achieved by having the transport device advance the items more quickly than they are processed in the following packaging station. The items are thereby under banking-up pressure. As a  
20 consequence of the banking-up pressure the circular items correspondingly arrange themselves to correspond to a two-dimensional hexagonal spherical pack.

In order that the items can distribute themselves into the  
25 individual lanes, the lateral distance between the rails must be slightly increased in front of the dividers. This increase begins approximately at a distance in front of the divider which corresponds approximately to the diameter of the items.

30 The middle divider projects preferably against the direction of transport and the front ends of the dividers arranged laterally thereof are offset staggered to the rear. The increase in the distance between the side rails is developed stepwise corresponding to this stagger. The height of the  
35 steps results in each case from the additional space required by the items when they pass out of the hexagonal close packing into the individual lanes, the

thickness of the dividers also having to be taken into account. The step height therefore corresponds to approximately 10 to 30 % of the diameter of the items. The distances between the side rails is preferably not widened at two right angles, but in the manner of a groove in an eighth- to a quarter-arc of a circle. The side rail thus bends outwards at an angle of 10 to 30 % at first and then runs on a section of an arc of a circle until it again runs parallel to the direction of transport.

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The dividers are moved back and forth in the direction of transport and transversely to it at the same time. The dividers are mounted on a common frame. This frame is expediently housed swivellable about a fulcrum at the rear, downstream end. An arm extends from the frame against the direction of transport and the front, upstream-side end of the arm is moved in the direction of transport and transversely to it by means of a cam gearing. The housing of the downstream-side end of the frame is developed such that a displacement of the frame in the direction of transport by a short distance of for example 15 mm is possible.

The cam gearing preferably consists of a star wheel with three or four teeth, the tips of the teeth being connected to a curved line as in a Maltese cross. This cam disk is driven by a motor. A roller at the upstream-side end of the arm rests against the cam disk and can for example be prestressed against the cam by means of a spring. At a distance of approximately  $1/3$  to  $1/4$  of the diameter of the cam disk an eccentric bolt is attached which protrudes into an elongated slit. When the cam disk turns the arm is thereby swivelled back and forth transversely to the direction of transport. Because the roller lies against the periphery of the cam disk, the arm and thus the dividers are moved back and forth in the direction of transport at the same time, as often as corresponds to the number of teeth of the cam disk. Thus, if the cam has four teeth, the back-and-forth movement transversely to the direction of transport is overlaid by four

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back-and-forth movements in the direction of transport. The cam disk turns at 0.5 to 4 revolutions/second.

The items are preferably fed to the lane divider at as low as possible a banking-up pressure. This can be achieved by placing a stationary pushover plate onto the transport device a short distance in front of the lane divider, so that the conveyor belts move through under the pushover plate and the items are pushed by the banking-up pressure over the pushover plate. The resulting friction acts against the banking-up pressure thereby reducing it. Another possibility is to separate the transport device from the lane divider and let the following transport device run more slowly. Finally there is also the possibility of slowing the movement of the items by making the rail somewhat narrower.

In a preferred version, the occurrence of a blockage is established by recording the movement of the items by means of a CCD camera or light barriers or by comparing the speed of transport within the individual lanes. The side rails are arranged displaceable transversely to the direction of transport, so that their distance can be increased. If a blockage occurs, the side rails are briefly moved apart, the wedging of the bottles being cleared or the formed bridge destroyed.

The overall railing arrangement is preferably divided into three rails, the first rail extending from the previous station, up to a distance which is somewhat greater than the width of the transport device, in front of the lane divider. The second rail, also called the formatting rail, joins it here. The free distance between the rails narrows in the area of the formatting rail, in order to force the cylindrical items into an ordered, hexagonal arrangement. To reduce the banking-up pressure and to meet the greater space requirement which the cylindrical items have when they run into the lane divider, the distance between the second rails increases somewhat at a point which lies, at a distance corresponding to a diameter of the items, before the tip of the lane divider.

This increase in distance between the rails is preferably stepwise. This has proved to be an effective means of avoiding blockages of the items in front of the lane divider. The third rail connecting to it widens if this is necessary because of the increased lateral space requirement of the items still running into the lane divider, likewise stepwise. The third rail is preferably designed swivellable about a pivot placed at the rear end, so that it can be opened at the front to clear blockages. The second rail can likewise be developed movable, for example by a similar cam gearing to the lane divider, movement in the same direction also being possible. The amplitude is for example 10 to 15 mm and the frequency approximately 0.5 to 4 Hz.

An embodiment of the invention is explained below with the help of the drawing. There are shown in:

Fig. 1 in top view, an apparatus for the distribution of a random stream of drinks bottles across several lanes;

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Fig. 2 a top view similar to that of Fig. 1, the drive for the lane divider also being shown;

Fig. 3 a side view of the apparatus of Fig. 1, and

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Fig. 4 a cam disk with a grooved track.

The apparatus for the distribution of a random stream of drinks bottles across several lanes 11 to 16 has a transport device 20, a lane divider 30 and a drive 40 for the lane divider 30.

The transport device 20 is made up of several conveyor belts 22, which can be chain-link conveyors and are arranged with as small as possible a distance between one another and at the same height, so that they form a practically continuous transport surface on which the drinks bottles 10 stand. Together, the conveyor belts 22 make a transport surface on which several drinks bottles 10 can stand side by side in the

shown embodiment say six drinks bottles 10. The direction of transport is shown in Fig. 1 by an arrow. The transport device 20 has first, side rails 24 which are extremely stable, as the bottles 10 are conveyed under banking-up pressure, i.e. the conveyor belts 22 run more quickly than the bottles 10 can actually be conveyed and be received for example by a following packaging station. The first rails 24 extend from the previous station, for example the filling station, which is not shown in the drawing, to a point at a distance of approximately 0.5 to 1 m in front of the lane divider 30, the first rails 24 having a uniform distance apart to this point. The second rails 26 join the first rails 24. The second rails 26 extend approximately up to the lane divider 30. The second rails 26 are profiled such that the distance between them decreases in the middle so that, observed from above, the transport track is waisted. The inner sides of the second rails 30 have steps 28, 29 at the end facing the lane divider 30. The first step 28 has a height of approximately 30 % of the diameter of the bottles 10, while the second step has a height of only approximately 10 %. Third rails 36, which extend approximately to the downstream-side end of the lane divider 30, and have further steps 38 in their front area, join the second rails 26.

The lane divider 30 has a frame 32, arranged above the transport track, from which plates 34 are suspended downwards as dividers. The frame 32 is arranged at a sufficient distance over the transport track, so that the bottles 10 can be transported through beneath it, and the plates 34 extend to just above the transport surface (Fig. 3) In the shown embodiment, five plates 34 are provided. These, together with the third rails 36, form the six lanes 11 to 16. The middle plate 34 projects furthest against the direction of transport. The two adjoining plates 34 are set back by approximately 1.5 to 2 bottle diameters and the two outermost plates 34 are for their part set back by  $1\frac{1}{2}$  to 2 bottle diameters. If the front ends of the plates 34 are joined, a V results. A plurality of small rollers 35 with a vertical axis is arranged along the upstream-side edges of the plates 34 (Fig. 3).

Through the steps 28, 29 and 38 the transport track widens in the area in which the front ends of the plate 34 lie. This widening is necessary, as the bottles 10 are arranged in the  
 5 waisted area between the second rails 26 corresponding to a two-dimensional hexagonal close packing so that six rows of bottles with the diameter  $d$  occupy a transport track with a width equal to  $d + d \times 5 \times \cos 30^\circ \approx 5.33 \times d$ . Distributed into lanes, six rows of bottles 10 occupy a transport track  
 10 width of  $6 \times d +$  the width of the plates 34, however.

As can be seen in Fig. 1, the steps 28, 29 and 38 are not rectangular, but the inner side of the second and third rails 26 widens at first at an angle of approximately  $30$  to  $45^\circ$  in a  
 15 grooved arc whose radius of curvature approximately corresponds to that of the surface of the bottles.

The first step 28 is at a distance which corresponds approximately to the diameter of the bottles, in front of the  
 20 point of the furthest forward-projecting middle plate 34, and the last step 38 is approximately a half bottle diameter in front of the furthest set-back, outermost plates 34.

The third rails 36 are swivellable about a fulcrum 50 at their  
 25 rear end by means of pneumatic cylinders 52, so that they open together at their front end by approximately 10 mm. The bottles 10 passing through each lane are counted by means of sensors 54. If there are differences within the individual lanes 11 to 16 or if no bottles are counted, this shows that a  
 30 blockage has occurred in front of the lane divider 30. A control signal is then generated which carries out a short opening and closing movement of the third rails 36 by means of the pneumatic cylinders 52.

35 In the embodiment shown in Fig. 2, one of the two second rails 26 is divided and the upstream-side part 78 can be swivelled by means of a cylinder 82 about a fulcrum 80 placed on the upstream side. A distance between the two second rails 26 can



thereby be changed and the formatting of the cylindrical items  
10 corrected if necessary.

In the embodiment of Fig. 2, a pushover plate 46 is provided  
5 approximately half-way along the second rails 26. This  
pushover plate 46 lies directly on the conveyor belts 22, so  
that the drinks bottles 10 are pushed over the gliding plate  
46 under the pressure exerted by the following drinks  
bottles 10. The friction force of the drinks bottles 10  
10 standing on the pushover plate 46 acts against the pressure  
exerted by the following bottles 10, so that the banking-up  
pressure is reduced after the pushover plate 46.

The frame 32 is carried by a beam 60. On the upstream side the  
15 beam 60 projects by around half a metre from the frame 32 and  
at this end slides on a support 61 (Fig. 3) which is fixed to  
the apparatus. On the downstream side the beam 60 ends  
approximately with the frame 32 and the plates 34 and here it  
is housed rotatable in an oblong hole 62 of a holder by means  
20 of a pin and at the same time able to be displaced by a few  
centimetres in the direction of transport. The beam 60 is  
loaded by a spring 56 with the lane divider 30 fixed thereto  
in the direction of transport. At the upstream-side end of the  
beam 60 there is a cam gearing 40 serving as a drive which  
25 moves this end of the beam 60 back and forth in the direction  
of transport and transversely to it. The cam gearing 40 has,  
as cam disk, a star wheel 66 which is formed by four concave  
cut-out sections, distributed uniformly on the periphery of a  
circular disk. The star wheel 66 is rotatably housed and has  
30 an eccentric bolt 68 at distance of approximately  $1/3$  to  $1/4$   
of its radius, which engages in a slit 70 of the beam 60. On  
its upstream-side end the beam 60 also carries a roller 72  
which is elastically pressed against the periphery of the star  
wheel 66 under the force of the spring 56. The star wheel 66  
35 is driven by an electric motor 58. The rotation of the star  
wheel 66 firstly, through the eccentric bolt 68, brings about  
a pendulum movement of the beam 60 transversely to the  
direction of transport, and secondly, because the roller 72  
follows the periphery of the star wheel 66 under the force of

the spring 56, a forward and backward movement of the beam 60 in the direction of transport. The amplitude of both movements is a few centimetres. This amplitude is reduced according to the ratio of the length of the beam 60 and the length of the plates 34, so that the front ends of the plates 34 however carry out a corresponding movement with an amplitude of only approximately 8 mm. As can be seen in Fig. 3, the star wheel 66 is arranged under the beam 60 and thereby supports this end of the beam 60.

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In the embodiment of Fig. 4, the star wheel 66 is replaced by a disk 74 with a grooved track 76, the grooved track 76 running approximately according to the periphery of the star wheel 66, so that the end of the beam 60 carries out the same swivelling and translation movement and therefore the lane divider 30 and the front end of the plates 34 also carry out the same superimposed orbital and linear movements. In the version of Fig. 4 the spring 56 is dispensed with, as the roller 72 is guided in constricted manner in the grooved track 76.

The star wheel 66 can also have three or another number of concave recesses and the end of the beam 60 has in each case a corresponding number of forward and backward movements in the direction of transport for each back-and-forth movement transversely to the direction of transport. The star wheel 66 and the disk 74 respectively revolve at a speed of approximately 0.5 to 4 revolutions/second.

In general the vibration or rotary movement of the lane dividers 30 is enough to effectively prevent a reciprocal wedging or a bridge formation of the bottles 10. In principle, the banking-up pressure in front of the lane divider 30 is to be as low as possible. This is achieved by the attachment of a pushover plate 46 (Fig. 2). The banking-up pressure in front of the lane divider 30 can also be reduced by transferring the bottles 10 onto a slower-running transport device in front of the lane divider 30.

The steps 28, 29 and 38 are an additional means of preventing wedging and bridge formation in exceptional cases. Each time a bottle 10 slides along a step 28, 29, 38, this causes the neighbouring bottles 10 to vibrate, whereby any wedgings are  
5 cleared. The grooved form of the steps has proved of particular value here, as the bottles 10, after crossing the step, encounter the entire circular arc of the groove here, whereby the impact is distributed over a larger surface and the bottle 10 involved is itself less deformed, but gives the  
10 neighbouring bottles a relatively strong jolt.

If, in spite of these two measures, wedgings or bridge formations still occur, a wedging can finally be cleared or a formed bridge destroyed by briefly opening and closing again  
15 the front ends of the third rails 36.

List of reference numbers

10	Drinks bottle
11 - 16	Lane
20	Transport device
22	Conveyor belt
24	First rail
26	Second rail
28, 29	Steps
30	Lane divider
32	Frame
34	Plates, divider
35	Rollers
36	Third rail
38	Steps
40	Cam gearing
46	Pushover plate
50	Fulcrum
52	Pneumatic cylinder
54	Sensor
56	Spring
58	Electric motor
60	Beam
61	Support
62	Oblong hole
66	Star wheel
68	Eccentric bolt
70	Slit
72	Roller
74	Disk
76	Grooved track
78	Part of 26
80	Fulcrum
82	Cylinder